

“Moving Realtime WSR-88D Base Data Over the NGI”

HPCC Final Report

Project Information

Title: Moving Realtime WSR-88D Base Data Over the NGI

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Primary project theme: Theme 1, NGI

Funding received: \$198K

Performance:

List all deliverables resulting from this project:

- Installed T3 into NCDC and paid for small portion of bandwidth cost
- Submitted change orders for proposed new RIDDS connections to NWS radars (37 total radars)
- Procured network and RIDDS SUN and LDM PC hardware
- NCDC created a web interface to NCDC mass storage device for data dissemination
- Completed installation of network and RIDDS hardware
- Completed theoretical modeling and optimal design of possible operational national network based upon CRAFT-2 prototype. The report is available via the web at <http://kkd.ou.edu/CRAFT%20Network%20Simulation.pdf> (see attached hardcopy of report)
- Created platform independent, Java-based WSR-88D level II data display module to read realtime data and put it on NCDC homepage for distribution to general public

Provide any URLs for information products developed:

<http://kkd.ou.edu/craft.htm>

<http://lwf.ncdc.noaa.gov/oa/radar/radarresources.html>

Identify any media produced or publication made as a result of this project:

- Droegemeier, Kelvin K., Jason J. Levit, Carl Sinclair, Kevin Kelleher, Mark Benner, Tim D. Crum, Stephen A. DelGreco, Linda Miller, David W. Fulker, and Harry Edmon, 2002: Project CRAFT: A Test Bed for Demonstrating the Real Time Acquisition and Archival of WSR_88D Level II Data. *Preprints*, 18th Interactive Information and Processing Systems Conference, Orlando, Florida. Amer. Meteor. Soc., January 13-18. <http://kkd.ou.edu/IIPS%20Preprint%20FINAL.pdf>
- Steven Smith, K. Kelleher, S. Lakshmivaran, 2002: Compression of NEXRAD (WSR-88D) Radar Data Using Burrows-Wheeler Algorithm. *Preprints*, 18th Interactive Information and Processing Systems Conference, Orlando, Florida. Amer. Meteor. Soc., January 13-18. <http://kkd.ou.edu/Smith%20Conference%20Paper.pdf>
- Droegemeier, Kelvin, K. Kelleher, et. al., 2001: Project CRAFT: A Test Bed for Demonstrating the Real Time Acquisition and Archival of WSR-88D Base (Level-II) Data, may be published in the *Bulletin of the American Meteorological Society*, or JTECH.

Include information regarding who to contact for these products:

- CRAFT project – Kevin Kelleher, NSSL or Kelvin Droegemeier, CAPS
- Network Simulation – S. Lakshmivaran, University of Oklahoma
- Data Archival, NCDC Mass Store, visualization program – Steve Del Greco, NCDC
- NWS adoption of the CRAFT methodology – Tim Crum, NWS/ROC

Project Summary:

The project to provide real-time delivery of WSR-88D data remains on schedule, and in many cases, ahead of schedule. Leveraging funds received from this HPCC program, additional funds were received in FY01 from both the ESDIM program and from OAR's Sea Grant Extension program. Consequently, nearly 40 radar sites around the country are now transmitting data to NCDC via the commodity Internet and Internet2 for archival in realtime. We anticipate that number to possibly grow, then level off to about 40 sites by the end of FY02. In fact, the NWS has suspended recording at over 20 radar sites alleviating the need for replacing the failing 8mm recorders at these sites and saving the NWS technician's time. See <http://kkd.ou.edu/craft.htm> for the latest figure showing radar sites sending data in realtime, sites for which the 8mm recording has been suspended, and anticipated future realtime sites.

The realtime data from each of the nearly 40 radars are being received by both NCDC and by CAPS (Center for Analysis and Prediction of Storms). NSSL is receiving data from those radars it requires for its research. CAPS is using the data for stormscale atmospheric modeling and NSSL is using it for WSR-88D algorithm development in support of the National Weather Service (NWS) WSR-88D radar program and for development of its WDSS-II multi-sensor workstation. Early in FY01, the project had its first major success when radars in the Phoenix, Arizona area failed to collect vital Level II data during a significant weather event. A PI from NSSL called from Japan during a business trip right after the event occurred and asked if we could help "recover" the data from the realtime archive at NCDC. Within hours NCDC had the data pulled from the archive and began ftp'ing the data back to the researchers at NSSL.

There have been many specific accomplishments achieved during this past FY. A large and successful workshop was held in Boulder, Colorado in February 2001 to discuss the project and get input and feedback from Government scientists, University researchers, and the private sector on the direction this project (CRAFT) is taking (<http://kkd.ou.edu/craft.htm>). NCDC was connected to Abilene via a T3 link this during 2001. NCDC archival statistics for the WSR-88D data now show our realtime data delivery method produced an increase in reliability over the in-situ 8mm recording tapes of over 30% (from 65% to over 95%). A platform independent, Java based software program to display and/or browse the WSR-88D data in realtime has just been completed by NSSL and given to NCDC for distribution via their web server.

The data compression team concluded its work in March 2001. The project has been using BZIP2, a popular open source compression scheme, coupled with the LDM data delivery software to achieve compression rates of between 6.4% and 25.4%, depending upon the type of weather event. The team was able to improve upon the BZIP2 scheme by preprocessing the data using specific knowledge about radar data. Its findings indicate an improvement in compression of 5% to 29% is achievable over the hybrid BZIP2 compression scheme. However, the present inclination of both NCDC and the user community is to continue to use the BZIP2 compression algorithm. They feel the benefits of using a well known, well publicized, open source software package outweigh the benefits of improving the compression by 5% to 29%. We will be recommending a partial implementation of the data pre-processing scheme, which should result in 0% to 19% additional compression without requiring changes at the "user" end. Further, the time expended to execute the preprocessing algorithm is more than compensated for by the increased efficiency and reduced time required to run the BZIP2 compression algorithm. A conference paper describing this ESDIM sponsored research was presented at the IIPS conference at the AMS annual meeting in Orlando in January 2002.

A study was done to investigate the underlying CRAFT network topology in anticipation of the CRAFT prototype becoming a candidate for the National Weather Service nationwide implementation of a realtime delivery system for the WSR-88D radar data. A simulation was done using Network Simulator, a software package designed to examine various loading conditions on a network. The package implements network protocols, traffic source behavior,

router queue management mechanism, and routing algorithms. A report describing this simulation is available on the CRAFT website.

The highest levels of management within the NWS were briefed in August by members of the team on the successes we experience with CRAFT. Recent indications are the NWS is close to adopting a CRAFT-like approach to replace the aging 8mm tape archive infrastructure. The NWS Radar Operations Center (ROC) has issued a memo to the NWS management recommending this realtime approach over the various in-situ approaches they were considering. (See <http://kkd.ou.edu/craft.htm> for the powerpoint slides that were briefed.)

Expenditure Summary

Identify areas where the funds were spent

- University of Oklahoma Center for Analysis and Prediction of Storms salaries: \$16K
- University of Oklahoma CIMMS Joint Institute salaries: \$52K
- NCDC (web interface for mass store - salaries): \$15K
- RIDDS maintenance and service (JI Salaries): \$20K
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Hardware & Comms

- FSL (Colorado radars, comms, hardware): \$10K
- NCDC (T3 comms, NCREN membership fees): \$25K
- Hardware (RIDDS PCs, SUNS, network devices): \$45K

Contracts

- Network Simulation (done through the Univ. of Oklahoma School of C.S.): \$15K
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Future Direction

The CRAFT project team is working directly with the NWS to design a cost-effective solution for them to adopt this methodology for their entire WSR-88D network. Members of the CRAFT project team, led by Tim Crum, are working with the NWS to refine a cost/benefit analyses study of CRAFT for the highest levels of management within the NWS. Ten alternatives have been prepared and examined by this NWS task force. It is the hope of the CRAFT project team that the NWS adopts this technology within the next two fiscal years.

We are beginning to look at using this same methodology to transmit the FAA Terminal Doppler Weather Radar (TDWR) data. TDWR radars are located around all major U.S. airports to help identify aviation hazards such as wind shear. These data are being considered as potentially important to “fill-in” areas between WSR-88D radars in that they can provide high resolution reflectivity and velocity data in the lowest elevations of the atmosphere.

A spin-off project called IFLOW, Inland Flooding Observation and Warning, has begun in the Carolinas. This project is designed to use the realtime data as input to a software package that estimates rainfall. The high-resolution rainfall estimates are input to a numerical model that predicts runoff and flooding. The output from the runoff model is fed into another numerical model operated by researchers at NC State University to predict coastal flooding due to land-falling tropical systems (see <http://www.nssl.noaa.gov/iflow> for more details).